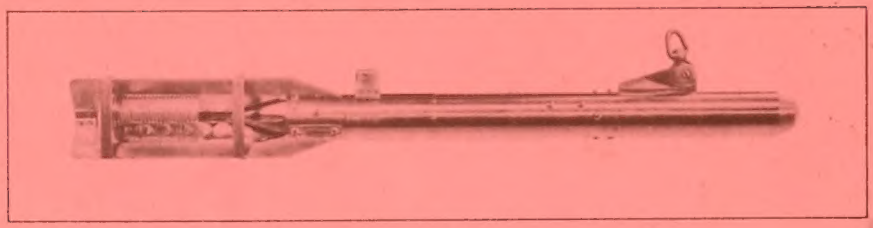
hydrographic office observers manual

H. O. PUB. NO. 606-c

BATHYTHERMOGRAPH OBSERVATIONS

BT every ½ hour
In same time-space interval on profile use 9 spaces
In every ½ hour



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THE U. S. NAVY HYDROGRAPHIC OFFICE
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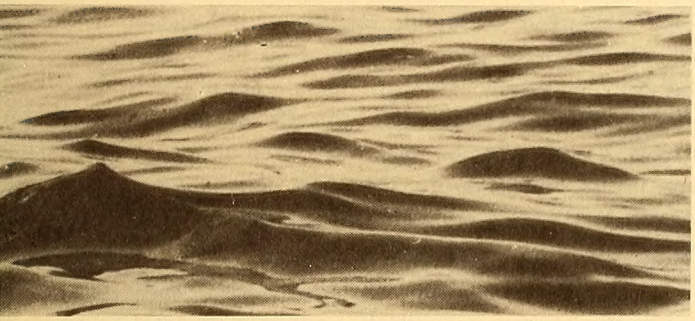
OF THE SECRETARY OF THE NAVY
WASHINGTON, D. C., 1952

BATHYTHERMOGRAPH



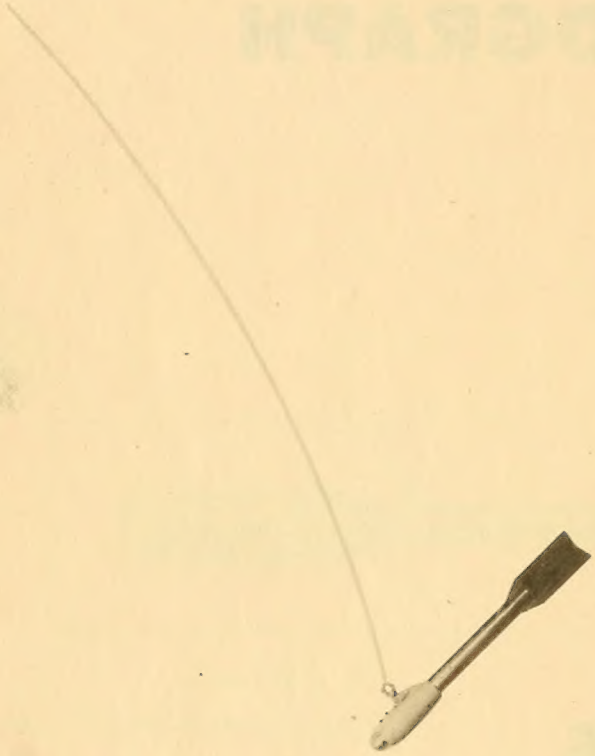
OBSERVATIONS

HOW A BT WORKS

MAKING A LOWERING

PROCESSING BT SLIDES

REPORTING PROCEDURE



Just as climate and terrain affect the strategy of armies, so seasonal and geographical characteristics of the oceans enter into the planning of the Navy. Today, waves and currents and ocean temperatures are influencing modern naval warfare in ways that are different but no less real than the limitations they placed on the old navies of sailing ships.

For both submarine and anti-submarine operations knowledge of the weather at the surface and beneath the surface of the sea is of vital importance. It is essential for strategic planning of convoy routes, speeds of advance, and sailing times. It determines the allocation of escort craft to afford adequate protection in each operations area. It determines whether it is safer to use fast unescorted ships or slower vessels moving in convoy. And it delineates those areas where air escort is needed.

Subsurface weather information is equally important in the strategy of submarine operations. It outlines the patrol areas where enemy shipping losses are most likely. It determines the size of the areas allotted to each submarine as well as the most efficient number of submarines that can be used in any area of operations. It also determines the placement of submarine listening posts for monitoring the movements of enemy task groups.

Apart from its strategic importance, information concerning the weather beneath the surface of the sea is a fundamental contribution to the science of oceanography upon which the development of improved sonar, sofar, underwater communications, and underwater weapons and mines is so dependent.

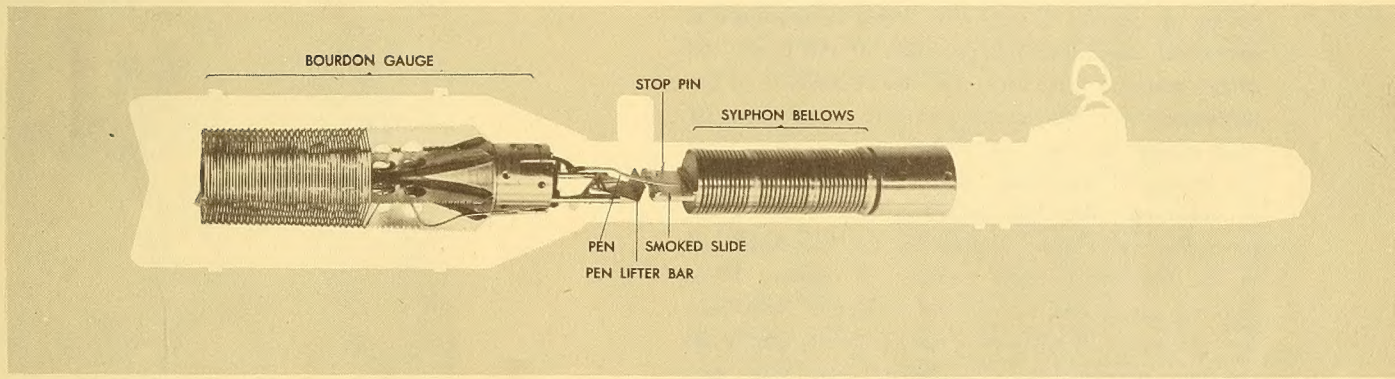
The best single index to subsurface weather conditions is the temperature distribution in the top layers of the ocean. The best instrument for measuring this distribution is the bathythermograph (BT)—the device which records how the sea temperature varies with depth.

Temperature-depth measurements vary, but their variations are not random; they vary with area and with time of year. If enough BT observations are made, the average conditions can be determined. Since the strategic and research value of bathythermograph information increases as the number of recorded BT observations increases, it is essential that ships of the Navy continue to make observations and to forward the resulting information to the Hydrographic Office.

HOW A BT WORKS

The bathythermograph is designed to obtain a record of the temperature of sea water at moderate depths. It can be operated while the ship is underway at speeds up to 18 knots.

The temperature element, corresponding to the mercury column in a glass thermometer, consists of a long length of fine copper tubing filled with xylene. The tubing is wound around inside the tail fins of the BT and is in direct contact with the sea water.



As the xylene expands or contracts with the changing water temperature, the pressure inside the tubing increases or decreases. This pressure change is transmitted to a bourdon gauge, a hollow brass coil spring which carries a stylus at its free end. The stylus records the movements of the bourdon, as it expands or contracts with changes of temperature, on a smoked-glass slide. The slide is held rigidly on the end of a coil spring enclosed in a copper bellows or sylphon.

Water pressure, which increases in proportion to water depth, compresses the sylphon as the BT sinks. This pulls the slide toward the nose of the BT at right

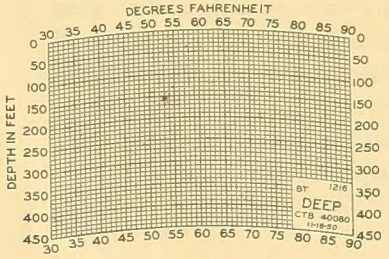
angles to the direction in which the stylus moves to record temperature. When the BT is raised toward the surface, the spring expands the sylphon to its original shape. Thus the trace scratched on the smoked surface of the slide is a combined record of temperature and pressure, the pressure being proportional to depth.

Since external pressure slightly affects the internal pressure of the xylene in the bourdon, and since temperature changes also influence the movement of the sylphon, each instrument must be carefully calibrated by the manufacturer.

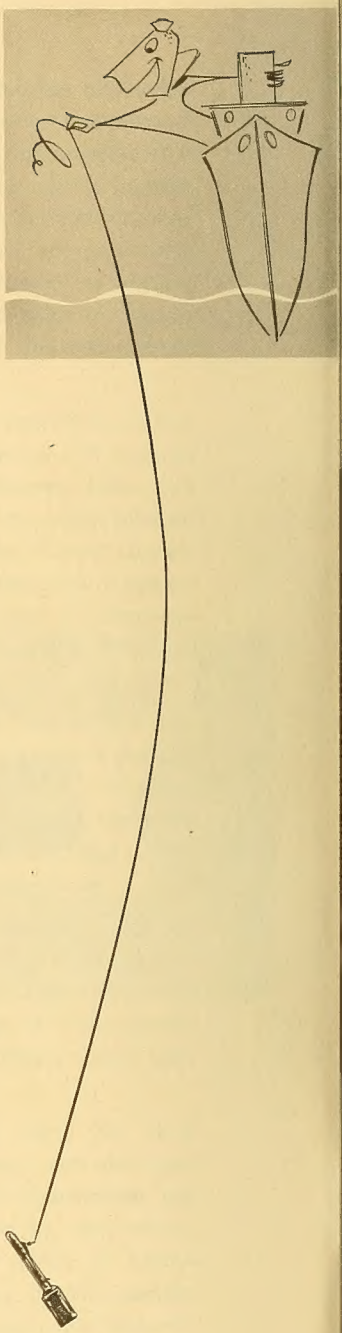
A special grid is supplied for each instrument for converting the stylus trace to temperature and depth readings. From an examination of the grid, you will note that the temperature lines are not exactly straight and vertical, but curve slightly to the left with increasing depth. Likewise, the depth lines are not exactly arcs of circles with radius equal to the length of the stylus, but also allow for thermal expansion of the sylphon.

At a temperature of 105° F, the recording stylus brings up against a stop pin; if this temperature is exceeded, permanent deformation of the brass coil of the bourdon will occur, and the calibration of the instrument will be ruined. For this reason, the BT must always be kept out of the sun and away from the vicinity of fire rooms, steam pipes, and so forth. An instrument that has been overheated may often have the stylus arm jammed by the pen-lifter bar in the high-temperature position. If another BT is aboard, use it and turn in the damaged instrument for adjustment. If a spare is not available, gently lift the stylus arm from the pen-lifter bar and let the arm swing back toward the low-temperature side.

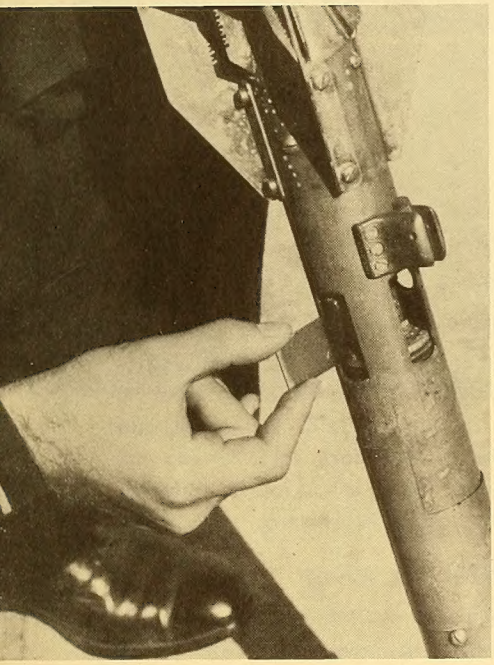
The temperature calibration will henceforth be in error as a result of deformation of the bourdon. Record on the BT log sheet that the BT calibration is uncertain beginning with the next slide, and turn in the instrument for recalibration at the first opportunity.



BT grid



MAKING A BT LOWERING



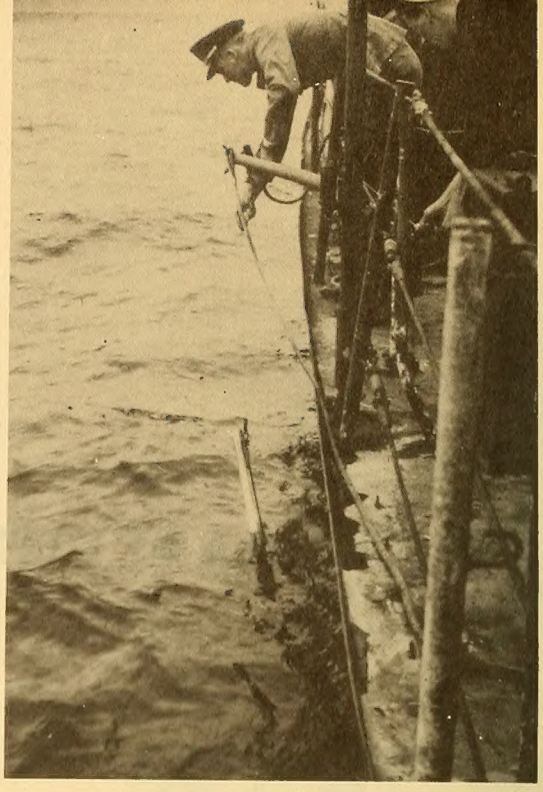
The BT is designed for lowering from a ship underway at speeds up to 18 knots. Best results, however, are obtained when the speed is not in excess of 12 knots. At higher speeds, unless the sea is very smooth, only an experienced operator should attempt to operate the winch. New operators should practice lowerings and recoveries with a dummy BT, before undertaking the operation with an actual instrument. Operation of the BT winch cannot be learned from reading a description any more readily than one can learn to pitch a baseball or bowl 300 by reading a manual. Nevertheless, the essential steps, together with some useful hints, are outlined below.

PUT THE SLIDE IN THE BT

Hold the slide by the edges and inspect it to be sure that it has a well-smoked surface. Then, insert it into its bracket. The edge with the bevelled corner goes in first, the bevel toward the nose of the BT. Push the slide all the way home against the stop pin. It is important to be sure that the slide is fully pushed in; otherwise the temperatures recorded will be fictitiously low. With the slide fully in, the stylus will be brought against the smoked surface when the sleeve is moved back to cover the slide opening. To reduce extraneous scratches on the slide, do not move the sleeve back until the BT is ready to be put over the side.

EXAMINE THE WIRE AND CONNECTION TO THE BT

If the connection is frayed, rusted, or in any way doubtful, or if the wire is kinked, cut the faulty connection and make a new one. Check the swivel carefully, particularly the swivel pin. More BT's are lost by poor wire connections than from any other cause.

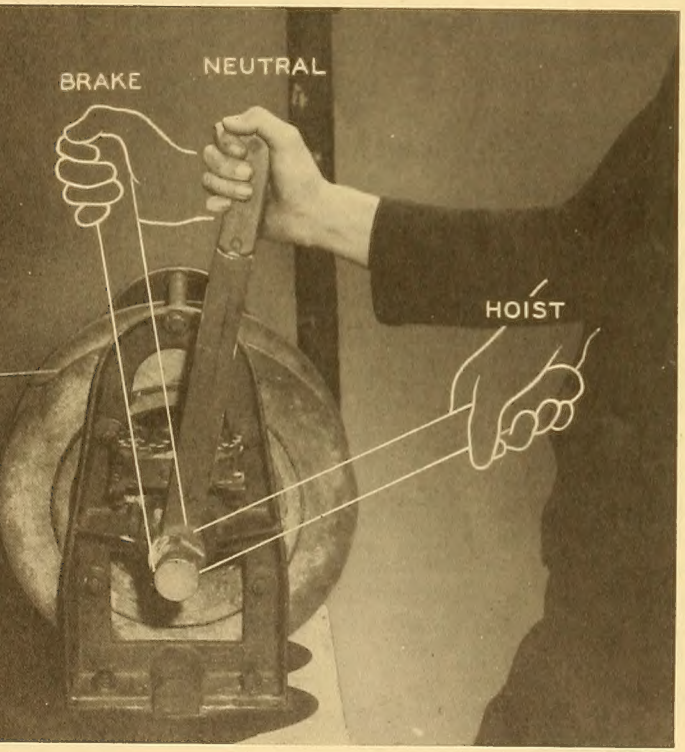


CHECK THE WINCH

The hand lever on the winch serves as both brake and clutch. It has three positions: (1) When it is vertical, the winch is in neutral and can turn in either direction. (2) When it is pulled inboard to the engaged position, the motor turns the drum in such a way that the wire is wound onto the drum. (3) When the lever is pushed outboard to the braking position, the brake is set, and the drum cannot rotate.

With the winch lever in neutral, turn on the motor for a moment to make sure that power is available. The shaft bearings should be well lubricated, and the drum should turn easily by hand.

The winch installation should be such that the wire comes across the top of the drum. The hand lever



should move toward the operator to engage the motor, and away from the operator to set the brake. Check these operating positions to make sure that the installation is correct and that the drum revolves freely in neutral.

PUT THE BT OVER THE SIDE

When permission has been obtained from the Officer of the Deck, pick up the BT, pull the sleeve down over the slide holder, and set the winch lever in neutral. With one hand, hold the BT at the rail, and with the other take up the slack wire, turning the winch drum by hand. When all slack is retrieved, set the brake. Set the counter at zero.

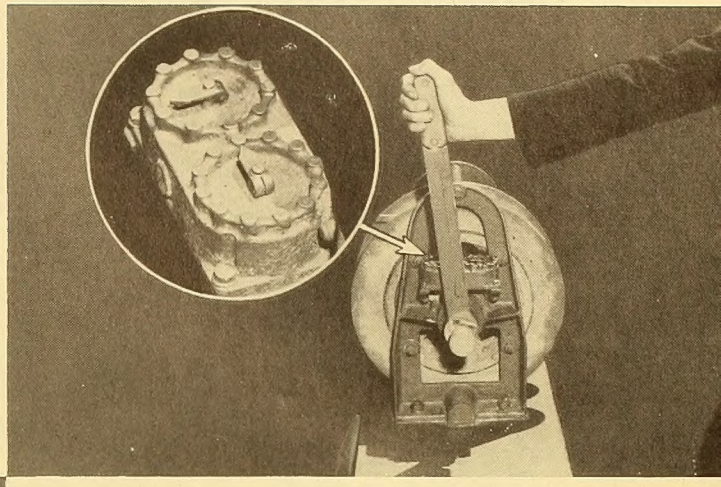
DROP THE BT INTO THE WATER

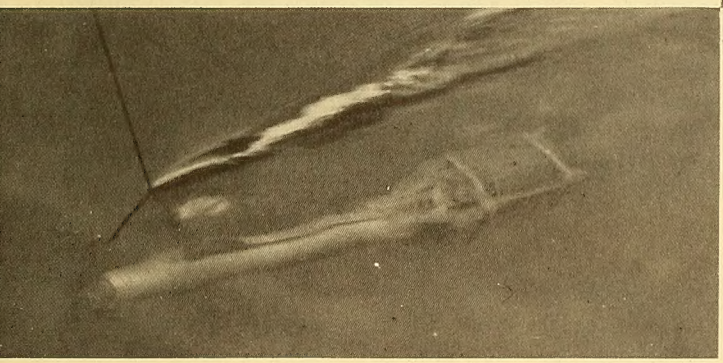
Turn on the winch motor, so that power is instantly available for the rest of the operation. Lower the BT into the water to such a depth that it rides smoothly, just below the surface. Put on the brake and hold the BT there for 30 seconds to enable the thermal element to come to the temperature of the surface water.

LOWER THE BT

Move the lever to the neutral position and allow the wire to pay out freely. Success in reaching the maximum depth with the BT depends primarily on two factors: having the winch-drum and towing-sheave

bearings lubricated so that friction is at a minimum, and getting the BT down below the ship's screw wash as soon as possible. With practice, it is possible to raise the BT slightly after the 30 seconds of towing at the surface is completed, skip it off the crest of



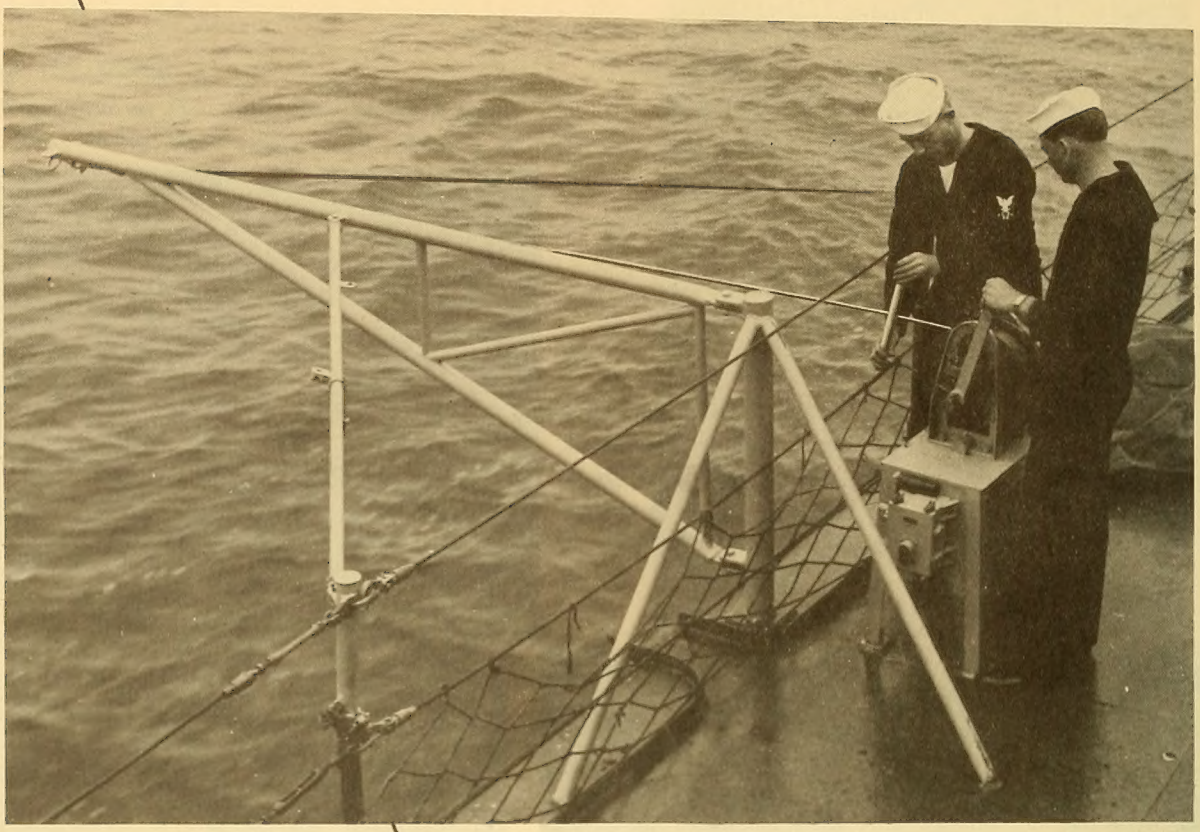


a wave so that it swings well forward, and then lower it rapidly while it is still forward of the boom. This reduces the backward speed of the BT relative to the water and enables it to sink deeper before it is influenced by the water churned up by the ship's screws.

When the ship is making more than 12 or 14 knots, there is enough drag on the wire to ensure that it will not slacken. At lower speeds, the wire may become slack between the winch and the towing block when the ship rolls. This slackness may cause backlash on the winch drum or a kink at the towing block. The operator should provide himself with a stick about 15 inches long to be used like an idler pulley on a slack belt to keep the wire taut. Do not touch the wire with the hands.

STOP AT THE PROPER DEPTH

When the counter indicates that the proper length of wire has been paid out, or when the last layer of wire on the drum has been reached, ease the hand lever to the brake position. Avoid a sudden jerk which might part the wire. The BT will now swim back up near the surface far astern. Check to see that the wire leads back properly for hauling in. If it does not lead from the towing block in a line perpendicular to the winch drum, adjust the boom guys until it does.

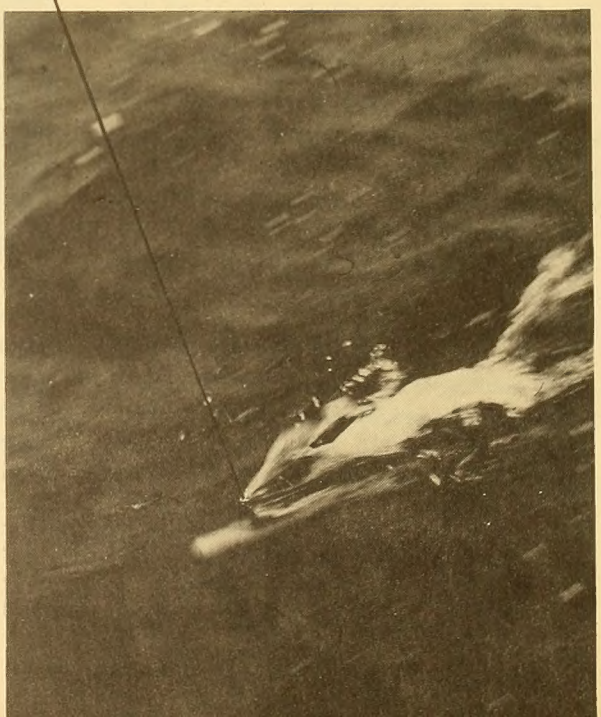


HAUL IN THE BT

Move the hand lever smartly from the brake position to the engaged position. Do not hesitate in going through neutral, or more wire will pay out. Use the stick to lay the wire evenly across the drum. If kelp or gulfweed fouls the wire, ease on the brake and clear the wire with a boat hook.

BRING THE BT ABOARD

When only 100 feet of wire is still out, the BT should be readily visible at the surface, 100 feet abaft the winch position. As the wire is hauled in, the BT will eventually reach a position where it will begin to "porpoise," breaking clear of the surface and swinging forward like a



pendulum. This is the most critical point in the operation. The operator must learn to keep the winch lever in the brake position when the BT is swinging away from the boom, to take in wire under power only when the BT is swinging toward the boom, and to move the lever from one position to the other without allowing the wire to pay out in the neutral position. If the wire is taken in while the BT is swinging away from the boom, it will invariably continue its swing into a full circle, wrapping the wire around the boom. If it is apparent that the BT may be in danger of wrapping around the boom, shift to neutral, allow the BT to drop into the water, and begin the recovery over again. With a little patience, the BT can be safely brought to within two or three feet of the towing block. The winch motor should be turned off at this point, eliminating the possibility of accidentally jamming the BT against the towing block.

The BT can then be brought aboard in various ways, depending on how the boom is rigged. Two men can pull in with a boat hook — one man on the boat hook and one to give the necessary slack with the winch lever. If the boom tops up, the BT can be brought aboard by one man hauling in on the topping lift. Similarly, if the boom swings horizontally, the BT can be brought aboard by casting off on the after guy and swinging the boom in with the forward guy.

Immediately the BT is recovered, move the sleeve toward the nose to take the stylus off the slide. This prevents the upper portion of the trace from becoming obscured as the instrument is handled.

REMOVE THE SLIDE AND SECURE THE EQUIPMENT

Slack off the wire and lay the BT on the deck. Set the brake. Take the bucket sample and note the temperature. Notify the bridge that the BT has been recovered. Secure the boom. Remove the slide from the BT, using a wire slide remover or a pencil to push it far enough out to be gripped by thumb and forefinger. Hold the slide only by the edges, being careful not to obscure the trace with smudges or fingerprints.

If another lowering is to be made soon, and there is no danger of overheating the BT, secure it in a convenient location near the winch without unshackling it; otherwise unshackle it and stow it in a cool place.

PROCESSING BT SLIDES

As soon as the slide is removed from the BT, examine it to be sure that a suitable trace has been obtained. Sometimes the smoked surface of the slide washes away on contact with sea water. If this has occurred, lower the BT again with a fresh slide. If it reoccurs, try a fresh lot, and handle the defective slides in accordance with Bureau of Ships instructions. With a sharp instrument, write the following information on the slide, being careful not to obscure or touch the temperature-depth trace.

(1) Slide number. Number slides consecutively between ports. If a ship is at sea for a week and uses forty slides, they should be numbered from 1 to 40.

(2) Time group. Use Greenwich Mean Time (0001 to 2400), giving the minute at which the BT entered the water.

(3) Date. Day, month, and year in numerals. Use Roman numerals for the month. 8 September 1950 is written 8 IX 50.

(4) BT number. The serial number of the BT is stamped near the nose of the instrument. This number is very important, as the laboratory that will process your slides has hundreds of grids, only one of which is a duplicate of yours. Without the proper grid, the information on your slide is worthless.

Always enter the information in the order given here. Avoid the temptation to improve an apparently faint trace by enlarging or tracing over it at the time you enter the data. The processing laboratory can copy an actual trace, however faint, by the delicate photographic processes it uses, but will invariably detect a retouched trace and reject it as spurious.

To fix the slide, first rinse off the sea water by dipping the slide gently once in clean fresh water. Then, dip it gently in the fixing lacquer, allow the excess lacquer to drain off, and place the slide in the slide box.

To prevent the slides from sticking to the box, it is good practice to put a length of string or strip of blotting paper under them, and to move each slide after about an hour to free it before the lacquer is fully dry and hard. If the slides are permitted to stick solidly to the box, the chances are that many of them will be broken when the time comes to remove them.

CAUTION: The BT lacquer is inflammable; it should not be used in the presence of lighted cigarettes. Since the lacquer evaporates quickly and is sometimes hard to procure, the dipping jar should be closed as soon as possible after the slide has been dipped. A mixture of one part lacquer to two parts thinner usually gives the proper thickness for BT slides.

REPORTING PROCEDURE

The BT log sheet (OPNav-25T-1189 new) is shown in facsimile below. All the information desired is important in interpreting the BT trace and the sonar conditions. It should be furnished with great care. For each lowering, the log sheet should be filled in as follows:

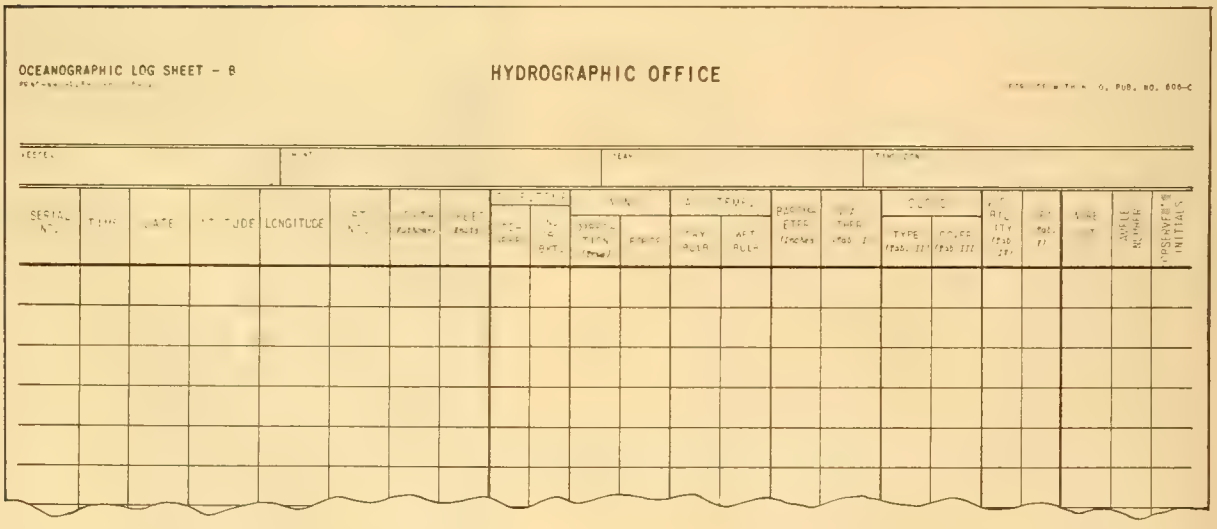
Ship's name, month, and year. Enter ship's name, month, and year in the spaces at the top of each sheet. Use Greenwich Mean Time throughout, unless special conditions require otherwise. In any case, indicate the kind of time used in the time zone space.

Serial No. Use here the slide serial number as described in (1) above.

Time. The Greenwich MeanTime, hour and minute, at which the BT entered the water.

Date. The Greenwich date.

Latitude and longitude. Enter here the ship's position in degrees and minutes at the time the BT entered the water. Be sure to indicate whether North or South latitude and East or West longitude. To obtain these positions accurately requires close coordination with


OCEANOGRAPHIC LOG SHEET – B

HYDROGRAPHIC OFFICE

SERIAL NO.	TIME	DATE	LATITUDE	LONGITUDE	BT NO.																

☆ U. S. GOVERNMENT PRINTING OFFICE : 1952 O—214347

table I

the navigating quartermasters on the bridge. Approximate dead-reckoning positions are NOT accurate enough for the BT log sheets. Astronomical, loran, or radar fixes should be plotted and the exact positions of the times of BT lowerings derived by interpolation.

BT No. Enter here the number stamped on the nose of the BT.

Depth. Enter here the sounding in fathoms.

Speed. The speed of the ship in knots.

Surface temperature. Enter the surface temperature of the sea water, and indicate whether it was obtained from a bucket sample (B) or from the injection thermometer in the engine room (I).

Wind force. Use either the Beaufort scale or, if available, an anemometer reading. If wind speed is used, be sure to enter the unit at the head of the column, i.e., knots, feet per second, etc. Also indicate the height of the anemometer above the waterline.

Air temperature. Enter the dry bulb and wet bulb temperatures.

Barometer. Enter the barometric pressure.

Weather by symbols. Enter here the code number as found in Table I.

Clouds. Enter the type and amount by code number from Tables II and III.

Visibility. Enter the code number from Table IV.

Sea. Enter the amount of sea by code number from Table V.

Wire out. Record the amount of wire paid out in lowering the BT.

Sample No. If a sample of sea water is taken at the same time as the BT observation, record the bottle number here.

Observer's initials. Initial the last column. If further remarks are required, make an asterisk (*) opposite the observer's initials, and record the remarks on the back of the sheet.

Whenever any significant quantity of log sheets and BT slides has accumulated, mail them together to:

Hydrographer
U. S. Navy Hydrographic Office
Washington 25, D. C.

00 - 49 no precipitation at the ship at the time of observation

00 - 19

No precipitation, fog, duststorm, sandstorm or drifting snow at the ship at the time of observation or during the preceding hour, except for 09

00 Cloud development not observed or not observable	*No hydrometeors except clouds*
01 Clouds generally dissolving or becoming less developed 02 State of sky on the whole unchanged 03 Clouds generally forming or developing	*Characteristic change of the state of sky during past hour*
04 Visibility reduced by smoke, e.g., veldt or forest fires, industrial smoke or volcanic ashes 05 Dry haze 06 Widespread dust in suspension in the air, not raised by wind at or near the ship at the time of observation 07 Dust or sand raised by wind at or near the ship at the time of observation, but no well developed dust devil(s), and no duststorm or sandstorm seen 08 Well developed dust devil(s) seen at or near the ship within last hour, but no duststorm or sandstorm 09 Duststorm or sandstorm within sight of the ship or at the ship during the last hour	*Haze, dust, sand, or smoke*
10 Light fog (visibility 1100 yds. or more)	
11 Patches of 12 More or less continuous	*Shallow fog at the ship not deeper than about 33 ft.*
13 Lightning visible, no thunder heard 14 Precipitation within sight, but not reaching ground at the ship 15 Precipitation within sight, reaching ground, but distant (i.e., estimated to be more than 3 miles from the ship) 16 Precipitation within sight, reaching ground, near to but not at the ship 17 Thunder heard, but no precipitation at the ship	
18 Squall(s) 19 Funnel cloud(s) (tornado or waterspout)	*Within sight during the last hour*

20 - 29

Precipitation, fog or thunderstorm at the ship during the preceding hour but NOT at the time of observation

20 Drizzle (not freezing) 21 Rain (not freezing) 22 Snow 23 Rain and snow 24 Freezing drizzle or freezing rain	*Not falling as showers*
25 Shower(s) of rain 26 Shower(s) of snow, or of rain and snow 27 Shower(s) of hail or of hail and rain 28 Fog 29 Thunderstorm (with or without precipitation)	

30 - 39

Duststorm, sandstorm or drifting snow

30 Slight or moderate duststorm or sandstorm	*Has decreased during preceding hour*
31 Slight or moderate duststorm or sandstorm	*No appreciable change during preceding hour*
32 Slight or moderate duststorm or sandstorm	*Has increased during preceding hour*
33 Severe duststorm or sandstorm	*Has decreased during preceding hour*
34 Severe duststorm or sandstorm	*No appreciable change during preceding hour*
35 Severe duststorm or sand storm	*Has increased during preceding hour*
36 Slight or moderate drifting snow 37 Heavy drifting snow	*Generally low*
38 Slight or moderate drifting snow 39 Heavy drifting snow	*Generally high*

40 - 49

Fog at the time of observation

40 Fog at a distance at the time of observation, but not at the ship during the last hour, the fog extending to a level above that of the observer	
41 Fog in patches	
42 Fog, sky discernible 43 Fog, sky not discernible	*Has become thinner during preceding hour*
44 Fog, sky discernible 45 Fog, sky not discernible	*No appreciable change during preceding hour*
46 Fog, sky discernible 47 Fog, sky not discernible	*Has begun or has become thicker during preceding hour*
48 Fog, depositing rime, sky discernible 49 Fog, depositing rime, sky not discernible	

50 - 99 precipitation at the ship at the time of observation

50 - 59

Drizzle at time of observation

50 Drizzle, not freezing, intermittent 51 Drizzle, not freezing, continuous	*Slight at time of observation*
52 Drizzle, not freezing, intermittent 53 Drizzle, not freezing, continuous	*Moderate at time of observation*
54 Drizzle, not freezing, intermittent 55 Drizzle, not freezing, continuous	*Thick at time of observation*
56 Drizzle, freezing, slight 57 Drizzle, freezing, moderate or thick 58 Drizzle and rain, slight 59 Drizzle and rain, moderate or heavy	

60 - 69

Rain at time of observation

60 Rain, not freezing, intermittent 61 Rain, not freezing, continuous	*Slight at time of observation*
62 Rain, not freezing, intermittent 63 Rain, not freezing, continuous	*Moderate at time of observation*
64 Rain, not freezing, intermittent 65 Rain, not freezing, continuous	*Heavy at time of observation*
66 Rain, freezing, slight 67 Rain, freezing, moderate or heavy 68 Rain or drizzle and snow, slight 69 Rain or drizzle and snow, moderate or heavy	

70 - 79

Solid precipitation not in showers at time of observation

70 Intermittent fall of snow flakes 71 Continuous fall of snow flakes	*Slight at time of observation*
72 Intermittent fall of snow flakes 73 Continuous fall of snow flakes	*Moderate at time of observation*
74 Intermittent fall of snow flakes 75 Continuous fall of snow flakes	*Heavy at time of observation*
76 Ice needles (with or without fog) 77 Granular snow (with or without fog) 78 Isolated starlike snow crystals (with or without fog) 79 Ice pellets	

80 - 99

Showery precipitation, or precipitation with current or recent thunderstorm

80 Rain shower(s), slight 81 Rain shower(s), moderate or heavy 82 Rain shower(s), violent 83 Shower(s) of rain and snow mixed, slight 84 Shower(s) of rain and snow mixed, moderate or heavy 85 Snow shower(s), slight 86 Snow shower(s), moderate or heavy 87 Shower(s) of soft or small hail with or without rain or rain and snow, slight 88 Shower(s) of soft or small hail with or without rain or rain and snow mixed, moderate or heavy 89 Shower(s) of hail with or without rain or rain and snow mixed, not associated with thunder, slight 90 Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder, moderate or heavy	
91 Slight rain at time of observation 92 Moderate or heavy rain at time of observation 93 Slight snow or rain and snow mixed or hail * at time of observation 94 Moderate or heavy snow, or rain and snow mixed or hail * at time of observation	*Thunderstorm during preceding hour but not at time of observation*
95 Thunderstorm, slight or moderate, without hail * but with rain and/or snow at time of observation 96 Thunderstorm, slight or moderate, with hail * at time of observation 97 Thunderstorm, heavy, without hail * but with rain and/or snow at time of observation 98 Thunderstorm combined with duststorm or sandstorm at time of observation 99 Thunderstorm, heavy, with hail * at time of observation	*Thunderstorm at time of observation*

* Hail, small hail, soft hail.

table II cloud type

Code	
0	Stratus or fractostratus
1	Cirrus
2	Cirrostratus
3	Cirrocumulus
4	Altocumulus
5	Altostratus
6	Stratocumulus
7	Nimbostratus
8	Cumulus or fractocumulus
9	Cumulonimbus

table IV visibility

Code		
0	Dense fog	50 yards
1	Thick fog	200 yards
2	Fog	400 yards
3	Moderate fog	1000 yards
4	Thin fog or mist	1 mile
5	Visibility poor	2 miles
6	Visibility moderate	5 miles
7	Visibility good	10 miles
8	Visibility very good	30 miles
9	Visibility excellent	over 30 miles

(Use range-finder readings of known landmarks, if possible.)

table III cloud cover

Code	
0	No clouds
1	Less than 1/10, or 1/10
2	2/10 and 3/10
3	4/10
4	5/10
5	6/10
6	7/10 and 8/10
7	9/10 and 9/10 plus
8	10/10
9	Sky obscured

table V sea height

Code	
0	Flat calm
1	Less than 1 foot
2	1 to 3 feet
3	3 to 5 feet
4	5 to 8 feet
5	8 to 12 feet
6	12 to 20 feet
7	20 to 40 feet
8	40 feet and over
9	Very rough, confused sea